

Firestop Contractors International Association

Tony Crimi, P. Eng., MASc. A.C. Consulting Solutions Inc. NBC/NFC Fire-Resistance & Fire Separations Canadian Code Requirements



.C. Consulting Solutions Inc. (905) 508-7256

NFPA – 2018 US Fire Statistics

1,345,000 Fires reported in the US



US Fire Loss Clock



One highway vehicle fire was reported every **182 seconds**.



One outside fire was reported every **48 seconds**.



A fire department responded to a fire every **24 seconds**.





One structure fire was reported every **66 seconds**.



One civilian fire injury was reported every **34 minutes**.



One home structure fire was reported every **90 seconds**.



One civilian fire death occurred every **2 hours and 35 minutes**.

Summary of U.S. Fire Problem

497,650 structure fires in the US (37% of total), resulting in:

- 3,655 civilian fire deaths (83% of all)
- 15,200 civilian fire injuries (84% of all)
- 11.1 billion in property damage (82%) (excluding \$12B from Californian Wildfires)
 - One structural fire every 63 sec



Source: NFPA Records

Summary of 2002 Canadian Fire Problem

Summary 1993 - 2002

Table 1 - Canada Fire Losses, Fire Deaths and Fire Injuries

Year	Estimated Population*	Number of Fires	\$ Loss	Per Capita \$ Loss	Fire Deaths	Death Rate**	Injuries	Injuries Rate**
1993	28 703 142	65 877	1 181 892 872	41.18	417	1.45	3 463	12.06
1994	29 035 981	66 719	1 151 546 461	39.66	377	1.30	3 539	12.19
1995	29 353 854	64 251	1 110 839 184	37.84	400	1.36	3 551	12.10
1996	29 671 892	60 138	1 163 336 515	39.21	374	1.26	3 152	10.62
1997	30 003 955	56 292	1 291 640 983	43.05	416	1.39	3 149	10.50
1998	30 300 422	57 602	1 175 553 135	38.80	337	1.11	2 697	8.90
1999	30 464 255	55 169	1 231 936 723	40.44	388	1.27	2 287	7.51
2000	30 737 179	53 720	1 185 233 793	38.56	327	1.06	2 490	8.10
2001	31 081 887	55 323	1 420 779 985	45.71	338	1.09	2 310	7.43
2002	31 485 263	53 589	1 489 012 263	47.29	304	0.97	2 547	8.09
10-Year Average		59 936	1 222 238 193	40.61	374	1.25	3 072	10.26

* Source: 2002 Census, Statistics Canada

** Fire deaths rate and fire injuries rate - number of deaths/injuries per 100 000 population per annum



Source: NFPA's Survey of Fire Departments for 2018 US Fire Experience.

NONCOMBUSTIBILE CONSTRUCTION

Combustibility in the Building Codes

ASTM dictionary Definition of "Noncombustible" :

• not capable of undergoing combustion under specified conditions.



Combustibility in the Building Codes

Noncombustible means that a material meets the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials."

Noncombustible construction means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other *building* assemblies.

Combustible means that a material fails to meet the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials."

Combustible construction means that type of construction that does not meet the requirements for *noncombustible construction*.

This is expanding in 2020 NBCC

Combustibility of Building Materials

3.1.5.1 Noncombustible Materials

1) Except as permitted by Sentences (2) to (4) and Articles **3.1.5.2.** to **3.1.5.24.**, **3.1.13.4.** and **3.2.2.16**., a building or part of a building required to be of noncombustible construction shall be constructed with noncombustible materials. (See also Subsection 3.1.13. for the requirements regarding the flame-spread rating of interior finishes.)

These represent exception... 24 Articles, 96 clauses, and 243 individual requirements !!!



Combustibility in the Building Codes

2020 NBCC will add 3rd type of Construction:

Encapsulated Mass Timber (EMTC)

Encapsulated mass timber construction means that. type of construction in which a degree of fire safety is attained by the use of encapsulated mass timber elements with an encapsulation rating and minimum dimensions for the structural timber members and other building assemblies.



A.C. Consulting Solutions Inc. (905) 508-7256



Fire Resistance

Common Terminology:

□ **<u>Fire Resistance</u>**



 Time in minutes that a material or assembly withstands passage of flame, temperature and retain structural integrity under conditions of CAN/ULC-S101 test

□ **Fire Protection Rating**

 Time in minutes that a closure withstands passage of flame, and retain structural integrity under Standard test conditions (various test Standards for closures)

Fire Compartment

 In a building, an enclosed space separated by vertical & horizontal fire separations (driven by Codes)

Fire Resistance

Common Terminology:

Fire Resistant Floor or Wall Assembly

- "Listed" fire-rated assemblies or
- generic fire rated floor or wall as determined by the National/Provincial Building Codes (I.e. Appendix D NBC, Tables for Part 9 <u>only</u>)

<u>Closures</u>

 Closure means a device or assembly for closing an opening through a fire separation or an exterior wall, such as a door, a shutter, wired glass or glass block, and includes all components such as hardware, closing devices, frames and anchors.



Fire Resistance

➤A "fire separation" is a construction assembly that acts as a <u>continuous</u> barrier to the spread of fire and/or smoke.

➢A fire separation may or may not need to have a Fire Resistance Rating



Fire Separations

Purpose of "Fire Separations"

(a) Impede movement of fire in order to Limit the potential fire size and <u>inhibit</u> <u>movement of smoke</u>



- (b) Contain the fire long enough to evacuate occupants and allow fire department to gain access
- (c) Act as components of a "fire compartment"

Fire Separations

Fire Compartments

Usually, several "fire separations" are used in combination to surround a given space to contain fire within it.



Fire Separations

Evaluation of "Fire Resistance"

Fire Resistance Rating – usually based on the assembly meeting the acceptance criteria in the standard CAN/ULC-S101-M, "Standard Method of Fire Endurance Tests of Building Construction and Materials".

NATIONAL STANDARD OF CANADA

CAN/ULC-S101-17

STANDARD METHODS OF FIRE ENDURANCE TESTS OF BUILDING CONSTRUCTION AND MATERIALS



Canada.

Standards

Council of Canada

Fire Performance Testing



Typical "real world" Fire Exposure Curves

Fire Performance Testing



CAN/ULC-S101 Standard Fire Exposure Curve

ASTM E119 Fire Resistance Curve



Fire Resistance Criteria

Generalized Acceptance Criteria (CAN/ULC-S101)

- No passage of flames or hot gases
- Temperature rise on the unexposed side limited to 140° C average or 180°C individual Includes "Roving TC" per ISO.
- Assembly must remain in place & not collapse under design loads
- No through openings created during the fire or hose stream test (up to 45 psi water pressure).

• Maximum temperature of steel structural supporting elements (floors, ceilings, beams, columns) of 593°C average, 704°C indiv.





FIRESTOPPING SERVICE PENETRATIONS

Mechanisms of Fire Spread





Leap-Frog Effect (New ASTME 2874 Standard 2019



NBCC & Firestop Systems

3.1.9.1.Fire Stopping of Service Penetrations

1) Except as provided in Sentences (2) to (5) and Article 3.1.9.4., penetrations of a *fire separation* or a membrane forming part of an assembly required to have a *fire-resistance rating* shall be

a) sealed by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems," has <u>an F rating not less than the fire-protection rating required for **closures** in the fire separation in conformance with Table 3.1.8.4., or</u>

b) cast in place (see Note A-3.1.9.1.(1)(b)).



Fire Resistance & Closures

Up to NBCC 2015

Firestopping has been considered to be a closure, meaning....







Closure Systems

Rating of Closures:

Table 3.1.8.4.Fire-Protection Rating of ClosuresForming part of Sentence 3.1.8.4.(2)

FRR of Fire Separation	Required FR of Closure		
45 min	45 min		
1 h	45 min		
1.5 h	1 h		
2 h	1.5 h		
3 h	2 h		
4 h	3 h		

NBCC & Firestopping

3.1.9.1. Fire Stops

2) Penetrations of a firewall or a horizontal fire separation that is required to have a fire-resistance rating in conformance with Article 3.2.1.2. shall be sealed at the penetration by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems," has an FT rating not less than the <u>fire-resistance rating</u> for the fire separation.

3) Penetrations of a fire separation in conformance with Sentence 3.6.4.2.(2) shall be sealed by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems," has an <u>FT rating not less than the fire-resistance rating</u> for the fire separation of the assembly.

(Note: Applies to limited condition for horizontal service space)



Firestop Systems



Continuity of "fire separations":

- 3.1.8.1. General Requirements
 - 1) Any wall, *partition* or floor assembly required to be a *fire separation* shall
 - a) except as permitted by Sentence (2), be constructed as a continuous element, and
 - b) as required in this Part, have a fire-resistance rating as specified (see Appendix A).

2) Openings in a *fire separation* shall be protected with <u>closures</u>, shafts or other means in conformance with Articles 3.1.8.4. to 3.1.8.17. and Subsections 3.1.9. and 3.2.8. (See Appendix A.)

• Openings and gaps must be protected <u>with a closure</u>, or be effectively <u>fire stopped.</u>

Requirements for Protection of Joints

- Any wall, partition or floor assembly required to be a fire separation shall:
 - a) ... be constructed as <u>a continuous element</u>
 - **b)** ... have a fire resistance rating as specified
- Only real Code Basis for Joint FS & Perimeter Barrier FS systems is general continuity requirement in 3.1.8.1





Fire Performance of Exterior Wall Assemblies

Section 3.2.3 of the NBCC addresses the construction of the exterior face of a building, and it's impact on adjacent properties or buildings by introducing requirements for separation distance of buildings and structures from one another, based on:

- 1) combustibility of the exterior wall of the building,
- 2) distance between adjacent buildings,
- 3) <u>fire resistance rating of the exterior wall</u> <u>assembly</u>, and
- 4) percentage of unprotected openings, if any.



Fire Performance of Exterior Wall Assemblies

Generally, the fire-resistance rating, construction and cladding for exposing building faces of buildings or fire compartments are shown in Table 3.2.3.7.

• Where max area of unprotected openings are permitted to be per column 2 of the Table, the FRR, Construction Type, and Cladding Type are as summarized below:

Table 3.2.3.7. Minimum Construction Requirements for Exposing Building Faces Forming Part of Sentences 3.2.3.7.(1) and (2)						
Occupancy Classifica- tion of Building or Fire CompartmentMaximum Area of Unprotected Openings Permit % of Exposing Bui Face Area		Minimum Required Fire-Resistance Rating	Type of Construction Required	Type of Cladding Required		
	0 to 10	1 h	Noncombustible	Noncombustible		
	> 10 to 25	1 h	Combustible or Noncombustible	Noncombustible		
Group F, Division 3	> 25 to 50	45 min	Combustible or Noncombustible	Noncombustible		
	> 50 to < 100	45 min	Combustible or Noncombustible	Combustible or Noncombustible		
	0 to 10	2 h	Noncombustible	Noncombustible		
	> 10 to 25	2 h	Combustible or Noncombustible	Noncombustible		
Division 1 or 2	> 25 to 50	1 h	Combustible or Noncombustible	Noncombustible		
	> 50 to < 100	1 h	Combustible or Noncombustible	Combustible or Noncombustible		

ASTM Standards Activity

ASTM "Leap Frog" Standard E2874-19

Draft standard evaluates the fire performance of an exterior wall assembly, principally the building perimeter spandrel system, for its ability to prevent the spread of fire to the interior of a room one adjacent storey above via fire spread from the exterior of a building.

The test sample includes the exterior wall spandrel panel assembly, fasteners, structural supports and any glazed openings.

Simulates a post flashover fire exposure within a compartment venting to the exterior of the building and spreading to the floor immediately above via the exterior of the building.

The test facility described in this Standard is modelled on that prescribed in ASTM E2307.





NBCC 2020 Code Changes



Canada's Code Development System



The National Research Council:

Canada's Science and Technology Institution
 NRC Institute for Research in Construction (IRC)
 NRC-IRC Canadian Codes Centre (CCC)

Provides research and administrative support to the overall system

NBCC Code Change Process



Canada's Code Development System



The Governing Principles:

- code users drive the code change process
- provinces and territories are involved at every step
- public review is key "check and balance"

The CCBFC does not approve a change unless due process has taken place.

Provincial Transition to NCC and NFCC

September 25, 2020

Ontario Signs Canada-wide Agreement on Construction Codes

On August 27, 2020, Ontario signed the Reconciliation Agreement on Construction Codes under the Canadian Free Trade Agreement.

In taking this important step, Ontario is committed to further harmonizing the Ontario Building Code and Ontario Fire Code with the National Construction Codes. The harmonization of codes will help reduce barriers related to trade, product manufacturing, and building design and maintenance.

The Agreement was jointly signed by the Minister of Municipal Affairs and Housing, with responsibility for Ontario's Building Code, and the Solicitor General, with responsibility for Ontario's Fire Code.

Key elements of the Agreement include:

- Greater alignment of technical requirements in Ontario's Codes with the National Construction Codes meaning that Ontario's Codes will be more harmonized with those in effect in other provinces and territories.
- Timely and consistent adoption of Construction Codes across Canada so that the same rules are in place at the same time.
- A transformed national code development system, including a new governance structure that will be more responsive to provinces and territories.
- Access to free National Construction Codes across Canada (in digital format).

Ontario's Building Code and Fire Code establish fire, health, safety, accessibility and energy efficiency standards for buildings in the province. While signing the Agreement means that the technical content of Ontario's Building and Fire Codes will begin to more closely reflect that of the National Construction Codes and Codes across the country, Ontario intends to maintain certain variations and exceptions in its Building Code and Fire Code that will differ from the National Construction Codes.

NBCC 2020 Final Public Review

Final public review ended March 13th 2020 *Release date expected end of 2021* due to COVID-19

Standing committee on Fire Protection has conducted nine 3 hour conference calls on penetration proposals.

All 17 IFC proposals have been recommended by SCFP for publications

 One additional penetration proposal under development for Part 9



IFC NBCC Firestopping Code Change Requests processed previously for 2020 NBCC Cycle

4 Proposals Approved for 2020 NBCC Publication through SC's

- 1. 3.1.8.3. Continuity of Fire Separations, Joints, ASTM E2307
- This proposed change adds a reference to Article 3.1.8.3. for the continuity of fire separations and clarifies the requirements applicable to abutting fire separations.
- 2. 3.1.9.1 Required Rating for Firestop Systems
- This proposed change revises the rating of firestopping to match the fire resistance ratings of the penetrated assembly.
- 3. 3.1.9.1 (1) Limiting "cast-in-place"
- This proposed change adds qualifications on the use of cast-in-place protection for pipes, ducts, electrical outlet boxes, totally enclosed raceways and other similar service equipment.
- 4. 3.1.9.5 Combustible Piping Transitions
- Description: This proposed change allows transitions between combustible and noncombustible piping at fire separations, provided the piping is sealed at the penetration by a fire stop with an F rating.

One Item Approved Editorially

Revise terminology - the term 'Firestop' has been submitted to replace the word 'Fire Stop'. (The ULC Standard, CAN/ULC S-115, is named, "The Standard Method of Fire Tests of Firestop Systems").

IFC NBCC Firestopping Code Change Requests

Code	Item # / Description		
NBC	1361 - Required Rating for Fire Stop Systems		
NBC	1499 - Firestopping of Penetrations by Service Equipment		
NBC	1505 - Fire Stopping of Penetrations		
NBC	1508 - Rating of Fire Stops in Service Equipment Penetrations		
NBC	1523 - Rating of Fire Stops in Concealed Spaces		
NBC	1517 - Firestopping of Combustible Outlet Boxes		
NBC	1502 - Penetration by Outlet Boxes		
NBC	1501 - Combustible Piping Penetrations		
NBC	1576 - Penetrations through Fire Separations (Part 9)		
NBC	1500 – Continuity of Fire Separations (Appendix on E2307)		
NBC	1515 – Penetrations by Single Conductor Sheathed Cable		
NBC	1526 – Firestopping Individual Wire & Cable Penetrations		
NBC	1506 – Integrity of Fire Blocks		
NBC	1590 - Part 9 – Penetrations through Fires Separations		

Proposals under Consideration for 2020

Firestop related proposals in the current 2020 cycle

- F-rating to be equal to FRR (not FPR)
- Cast-in place penetration seals to be acceptable <u>only</u> for noncombustible penetrations
- Two Changes Exceptions to T-ratings for penetrations of firewalls and horizontal fire separations
- Clarifying (requiring?) that a penetration by a noncombustible raceway containing cables must be firestopped
- Remove apparent waiver of firestopping for single conductor cables in unlimited sized holes
- Remove blanket allowance for combustible outlet boxes without any protection
- Allow putty pads as an alternative to 24 inch outlet box separation
- Combustible pipe penetrations: 50 Pa rule limited to 4 stories and above, waived when building is sprinklered
- Appendix text to better describe the role of FRR joint systems

Perimeter Joint Systems



Floor and/or wall construction type and thickness

Joint width

Movement requirements

- Rating requirement
 - Firestopping materials

2020 NBCC Changes

[3.1.8.3.] 3.1.8.3. Continuity of Fire Separations

- [1] 1) Except as permitted by Sentence 3.6.4.2.(2), a *horizontal service space* or other concealed space located above a required vertical *fire separation*, including the walls of a vertical shaft, shall be divided at the *fire separation* by an equivalent *fire separation* within the *service space*.
- [4] 4) Except as provided in Sentence (5)-2020, T the continuity of a fire separation shall be maintained where it that abuts another fire separation, a floor, a ceiling, or a roof, or an exterior wall assembly. shall be maintained by a fire stop conforming to Sentence (3)-2020. (See Note A-3.1.8.3.(4).)
- [5] --) The fire stop required in Sentence (2)-2020 shall have an FT rating not less than the fire-resistance rating of the abutting fire separation when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems."
- [6] --) Joints located in a horizontal plane between a floor and an exterior wall shall be sealed by a *fire stop* that, when subjected to the fire test method in ASTM E 2307 "Determining Fire Resistance of Perimeter Fire Barrier System Using Intermediate Scale, Multi-Storey Test Apparatus," has an F rating not less than the *fire-resistance rating* of the horizontal *fire separation*.
- [7] --) Joints between ceilings and walls, between floors and walls, and between walls at corners need not comply with Sentence (2)-2020 where such joints consist of gypsum board that is attached to framing members and arranged so as to restrict the passage of flame and smoke through the joints.

2020 NBCC code brings new era for Canadian wood construction

Encapsulated Mass Timber Construction (NBC Part 3 and NFC Part 5)

 Introduction and definition of encapsulated mass timber construction (EMTC) as a third construction type permitted for buildings <u>up to 12</u> storeys in building height



EMTC Minimum Dimensions

Table 2 Minimum Dimensions of Structural Mass Timber Elements in Encapsulated Mass Timber Construction

Forming Part of Item 2.3

Structural Wood Elements	Minimum Thickness, mm	Minimum Width x Depth, mm x mm
Walls that are <i>fire separations</i> or exterior walls (1-sided exposure)	96	-
Walls that require a <i>fire-resistance rating</i> , but are not <i>fire separations</i> (2-sided exposure)	192	-
Floors and roofs (1-sided exposure)	96	-
Beams, columns and arches (2- or 3-sided fire exposure)	-	192 x 192
Beams, columns and arches (4-sided fire exposure)	-	224 x 224



Pipe Transition FS System





Pipe Transition FS System - NBCC

PROPOSED - 3.1.9.5 Combustible Piping Penetrations

7) Transitions between vertical *non-combustible* drain, waste and vent piping and *combustible* branches for drain, waste and vent piping are permitted where a combustible pipe transitions to a non-combustible pipe on either side of a *fire separation* provided they are not located in a *vertical service space*.

8) Except as permitted by Sentences (7), penetrations of a fire separation that incorporate transitions between *combustible* and *non-combustible* drain waste and vent piping shall be tested in accordance with sentence 3.1.9.5 (4)(a), where the penetrating pipe is combustible, or Article 3.1.9.1 where the penetrating pipe is non-combustible.

A-3.1.9.5.(7) the permission to use combustible piping also permits the use of combination systems consisting of both combustible and non-combustible piping. Combustible branches for drain, waste and vent are permitted to be used to connect to a plumbing fixture within a fire compartment. The integrity of the fire separation is maintained through the use of a fire stop system where the vertical stack piping penetrates the fire separation.

Proposals Approved by SC's in the 2020 NBCC/NFCC

Fire Alarm and Detection Systems (Part 3 and Part 9)

Introduces performance criteria that permit the use of wireless interconnected smoke alarms.

Home-Type Care Occupancies (Part 9)

Introduces provisions on a new type of occupancy classification called "home-type care occupancy" (Group B, Division 4), which allows affordable care accommodation in a single housekeeping building for residents who require in home-type care without compromising fire and life safety.

Solar Collectors (Part 4)

Introduces provisions for roof-mounted solar panels that are based on guidance from the Structural Commentaries (User's Guide – NBC 2015: Part 4 of Division B) to ensure that the additional loads due to the installation of solar panels are accounted for in the design of the building structure and that a harmonized method is used for the design.

Proposals in the 2020 NBCC/NFCC

Combustible Construction (Part 3)

 Introduces an additional compliance option for street access requirements in midrise combustible construction and reduces the 25% perimeter access to only 10% provided the exterior cladding is noncombustible.

Residential Sprinklers (Part 3)

 Expands application of NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes, to row houses, thus ensuring more economical designs and consistent approaches.

Fire Alarm and Detection Systems (Part 3)

 Expands requirements for fire alarms to require a low frequency audible signal as well as a visible signal in 10% of sleeping guest suites in hotels and motels.

Other Proposals under Consideration for 2020

NATIONAL BUILDING CODE OF CANADA

- Clarification of limitations on factory-assembled exterior wall panels
- Thermal Barriers Proposed addition of CAN/ULC-S145, "Standard Method of Test for the Evaluation of Protective Coverings for foamed plastic insulation – Full-Scale Room Test" (e.g. thermal barriers)
- Significant changes to Part 9 Fire & Sound Tables that could effect some exterior wall assemblies (e.g. EW1 & EW2)
- Safety Glazing potentially major restrictions on use of wired glass
- Updating of Farm Building Code
- Permission to use combustible (wood) windows in Part 3 buildings
- Limitations on installation of combustible cladding on 12-storey EMTC buildings
- Criteria for percentage of exposed mass timber on walls and ceilings within suites



The First Building Codes

Socrates – 341 BC

He shall set the joists against each other, fitting, and before inserting the dowels he shall show the architect all the stones to be fitting, and shall set them true and sound and dowel them with iron dowels, two dowels to each stone…"

Codes of Hammurabi – 2000 BC

In the case of collapse of a defective building, the builder is to be put to death if the owner is killed by accident; and the builder's son if the son of the owner loses his life..."

The importance of proper DIIM has always been understood ... and that has not changed !!



S. P. P.

Thank You QUESTIONS?

Contact Information:

Tony Crimi, A.C. Consulting Solutions Inc. <u>tcrimi@sympatico.ca</u> (905) 508-7256